Southern University of Science and Technology

Principle and selection of electric field antenna

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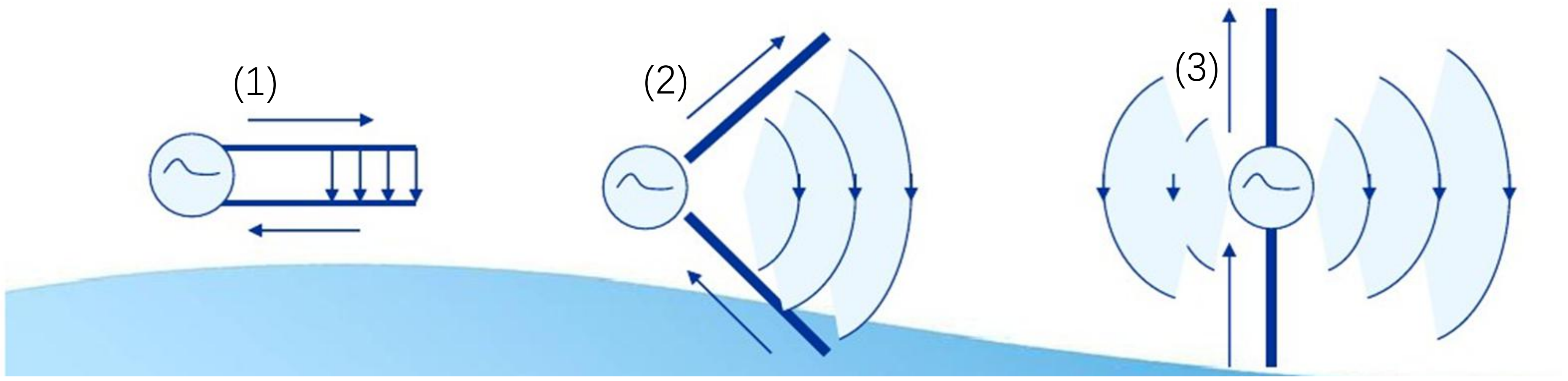
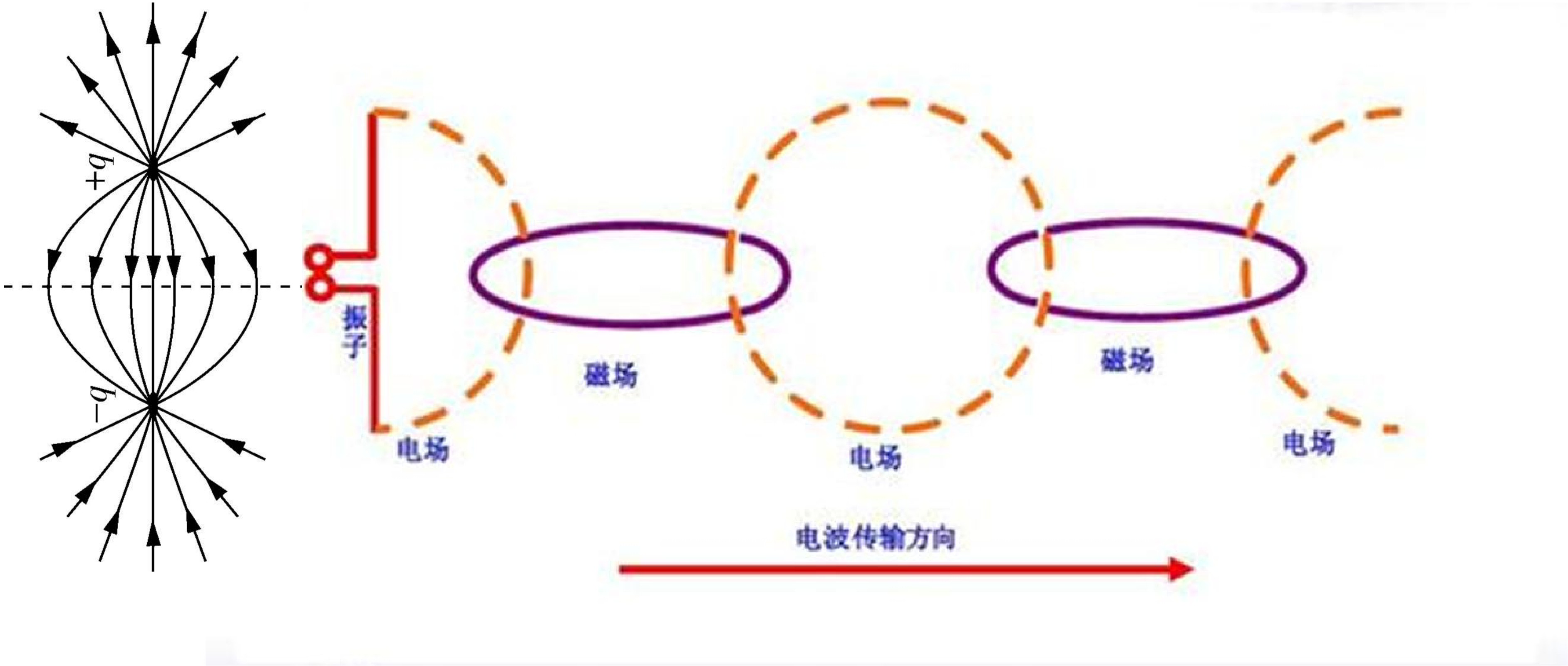
2020/09/30

Antenna theory and selection

- Electromagnetic radiation can be formed when a wire is carrying a time varying current.
- If the wires are close together, the radiation is very weak. (1)
- When the equivalent length is less than the wavelength, the radiation is very weak. (2)
- When the length of the wire is equal to the wavelength, the radiation is very strong. (3)



Antenna theory and selection



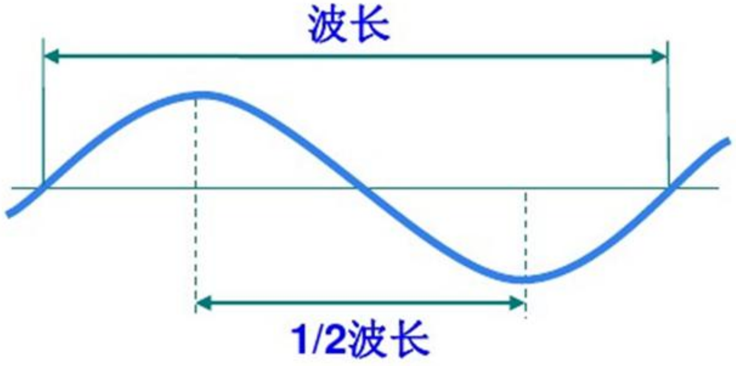
Time-varying electric fields can produce time-varying magnetic fields

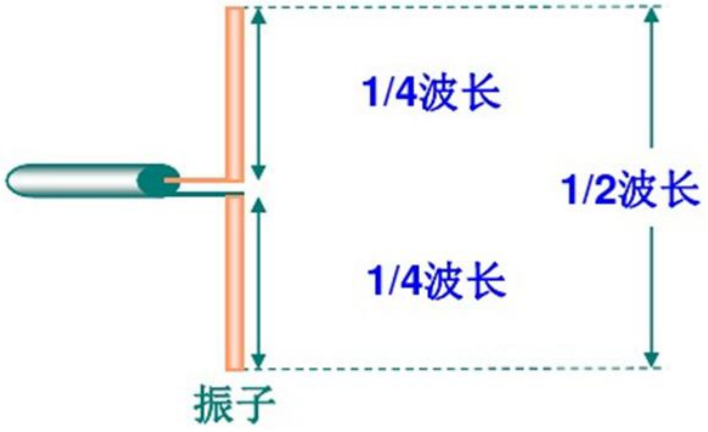
Question : static electric field / Fluctuations electric field

Antenna theory and selection

✧ 对称振子

两臂长度相等的振子叫做对称振子。每臂长度为四分之一波长。全长与波长相等的振子，称为全波对称振子。将振子折合起来的，称为折合振子。

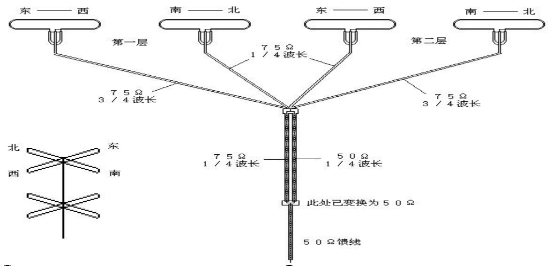


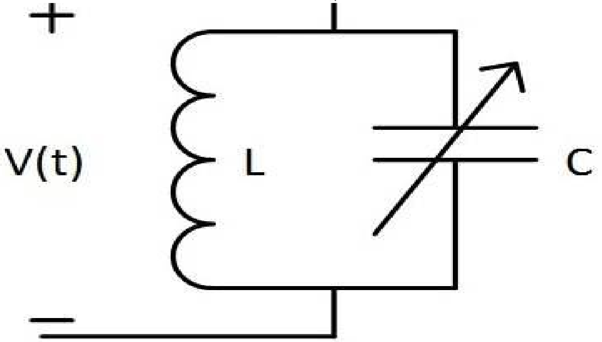


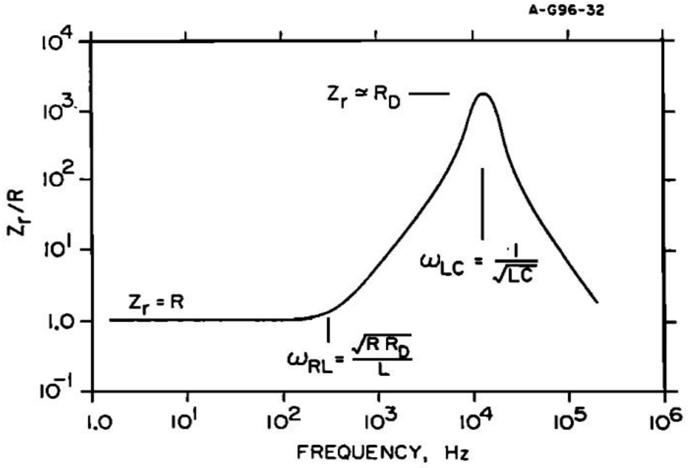
一个1/2波长的对称振子在
800MHz 约 200mm长
400MHz 约 400mm 长

Antenna theory and selection

- When $^{h}/_{\lambda} = 0.25$, the symmetric oscillator is in a series resonance state.
- when $^{h}/_{\lambda} = 0.5$, the symmetric oscillator is in a parallel resonance.
- When series resonance($^{h}/_{\lambda} = 0.25$), the resistivity changes slowly with frequency and has a better frequency response.



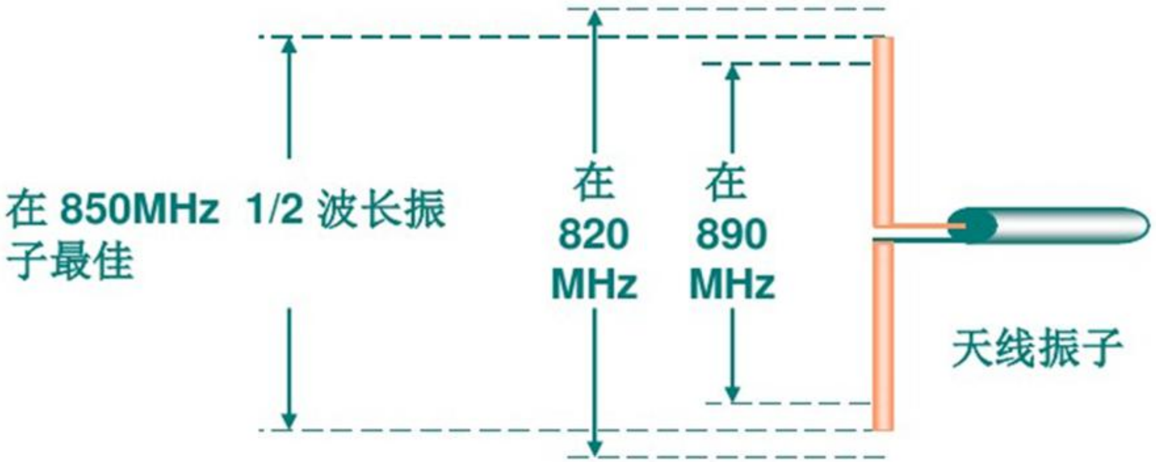




Antenna theory and selection

✧ 天线波长及频带与性能的关系

Length of the antenna will affect the frequency band and performance of the antenna.

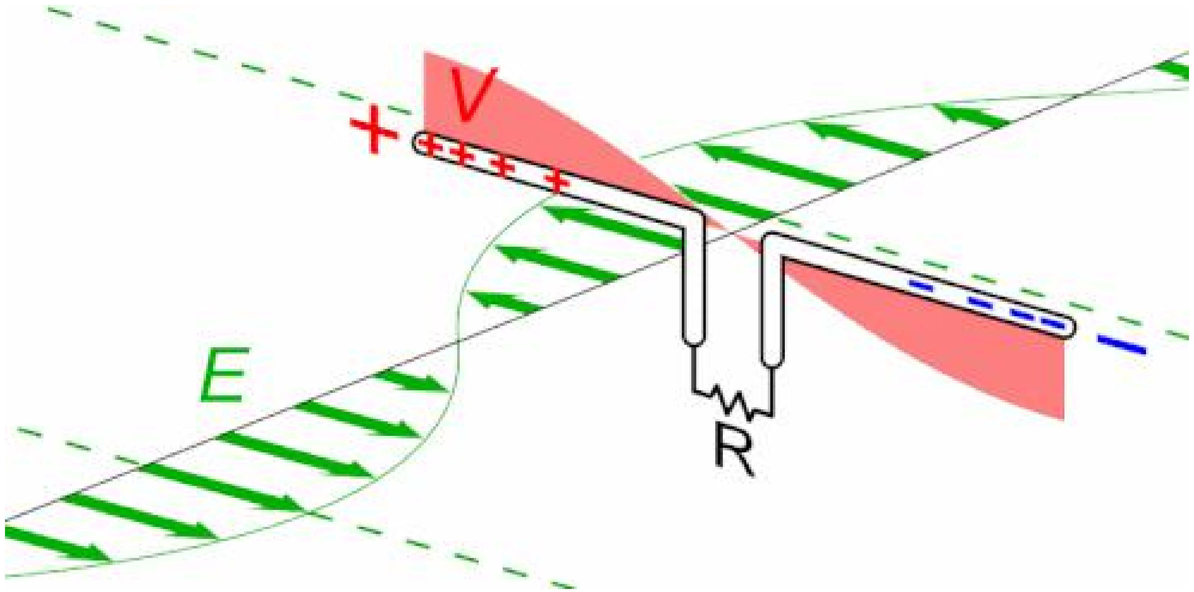


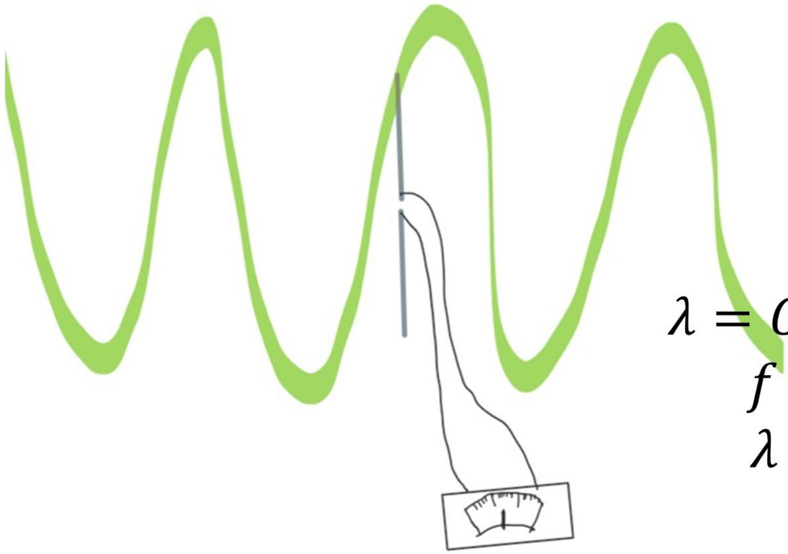
在 820 MHz 1/2 波长 为~ 180mm, 在890 MHz 为~ 170mm

175mm对~ 850MHz 将是最佳的

该天线的频带宽度 = 890 - 820 = 70MHz

Antenna theory and selection





$$\lambda = C * T = C/\mathrm{f}$$
$$f = 50M$$
$$\lambda \simeq 10\mathrm{m}$$

$$E(x) = E_0 \sin(kx - \omega t)$$
$$I(x) = I_0 \sin(kx - \omega t)$$

$$E = \frac{V}{2h}$$

$$I = \frac{V}{R}$$

Antenna theory and selection

General overview of foreign satellites

卫星名称	时间国家	探测高度	电场探测精度	测量频带	伸杆长度（m）	测量维数	测量方法
Explorer 45	1971 美国	磁层	0.1mV/m（直流）、10uV/m（交流）	0.3Hz~30KHz（直流）、35Hz~100KHz（交流）	5.08	二维	双天线
IMP 8	1973 美国	磁层		1kHz 以内	70		双天线
ISEE 1	1977 美国	磁层	0.5uV/m（直流），0.04uV/m_{rms}（交流）	0.19~1900Hz	95，73.5		双天线、双球形
EXOS-B	1978 日本	磁层	10mV/m	1~450Hz	51.5		双天线
EXOS-D	1982 日本	极区					双探针、离子束
Viking	1986 瑞典	1~2 R_E	0.2mV/m(>50mV/m)，0.025mV/m(<50mV/m)		40（轴向 4）		双探针
Freja	1992 瑞典	600~1700km			20（轴向 10）		双球形，电子束
Interball tail	1995 俄国	磁层	0.25~5 mV/m（直流）、0.01u 错误！未找到引用源。（交流）	0~200kHz	11，2.2	三维	双球形
Interball Auroral	1996	极光区以上	0.5mV/m（直流），1u 错误！未找到	0~30Hz			双球形

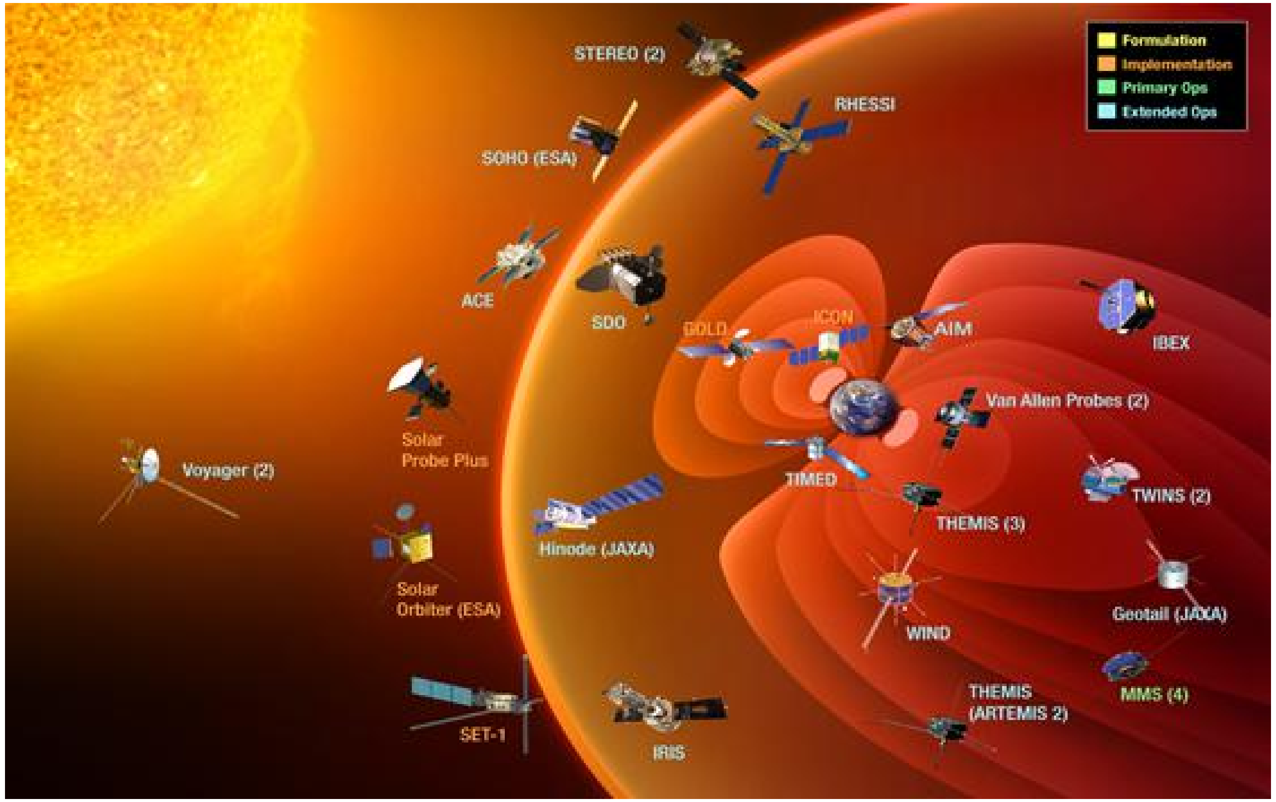
Antenna theory and selection

General overview of foreign satellites

	俄国		引用源。(交流)				
FAST	1996 美国	348~4159m	0.01mV/m	DC~20kHz（0~4MHz）	29（轴向 3）	三维	双天线
Polar	1996 美国	11500~57000km		DC~20kHz	100、130（轴向 13.8）	三维	双探针
Cluster II	2000 欧空局	25485~124875m	<0.1mV/m，50n 错误！未找到引用源。（交流）	10Hz~100kHz	50(轴向 35)	三维	双球形、电子束
DEMETER	2004 法国	697~722km	0.2 错误！未找到引用源。(500kHz)	0~3.25MH	2.3、4	三维	双球形
Themis	2007 美国	10~30R_E	0.1mV/m	DC~4kHz（DC~8kHz）	100	三维	双球形

MMS	60m	双球形
Juno	4.8m	双天线
Arase	5m	双线天线
Demeter	4m	双天线

Antenna theory and selection



Population of satellites : 18

Double antennas : 8

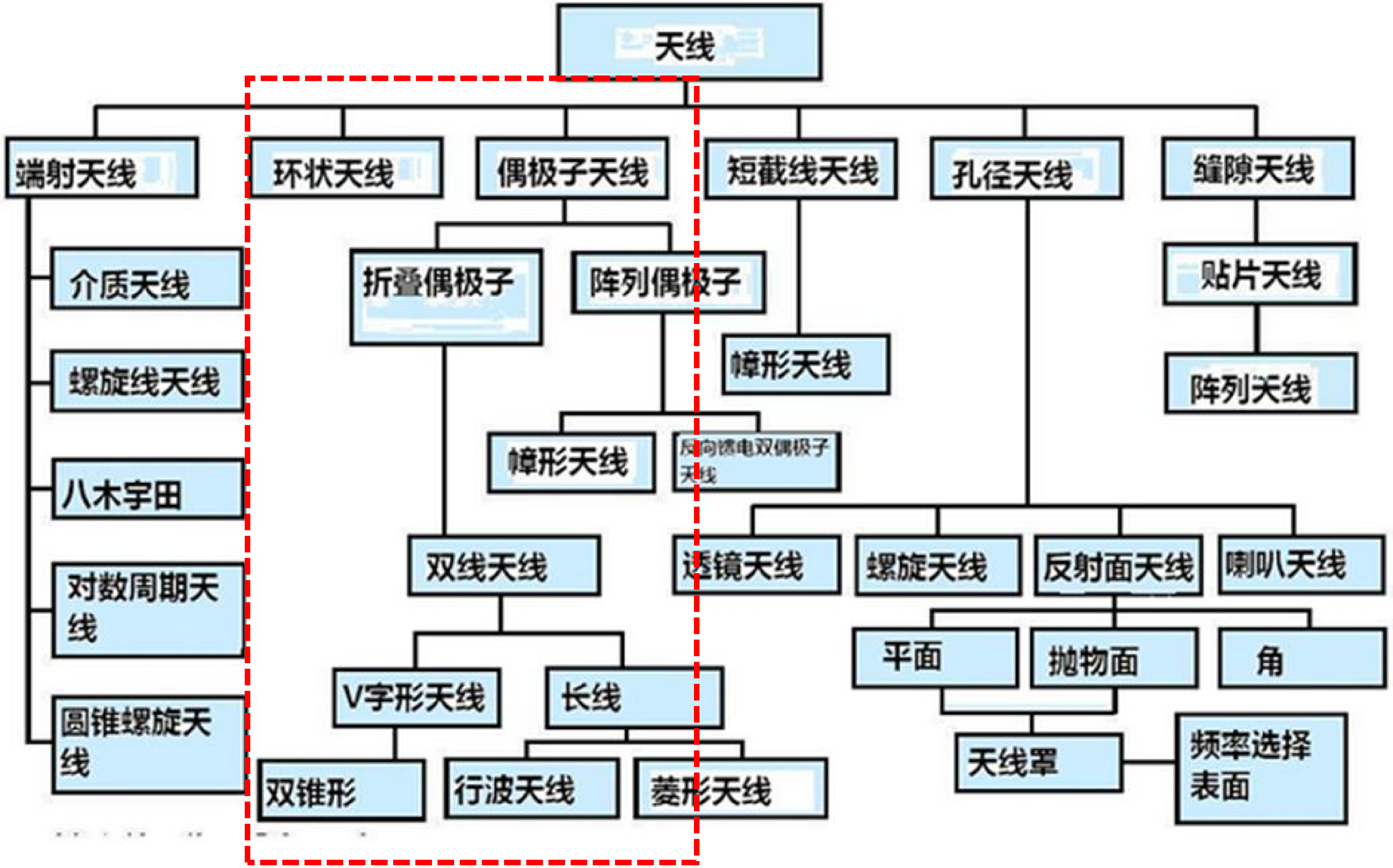
Double ball antennas : 10

Frequency range : DC~100KHz

Antenna Length : 5~100m

Antenna theory and selection

天线种类树



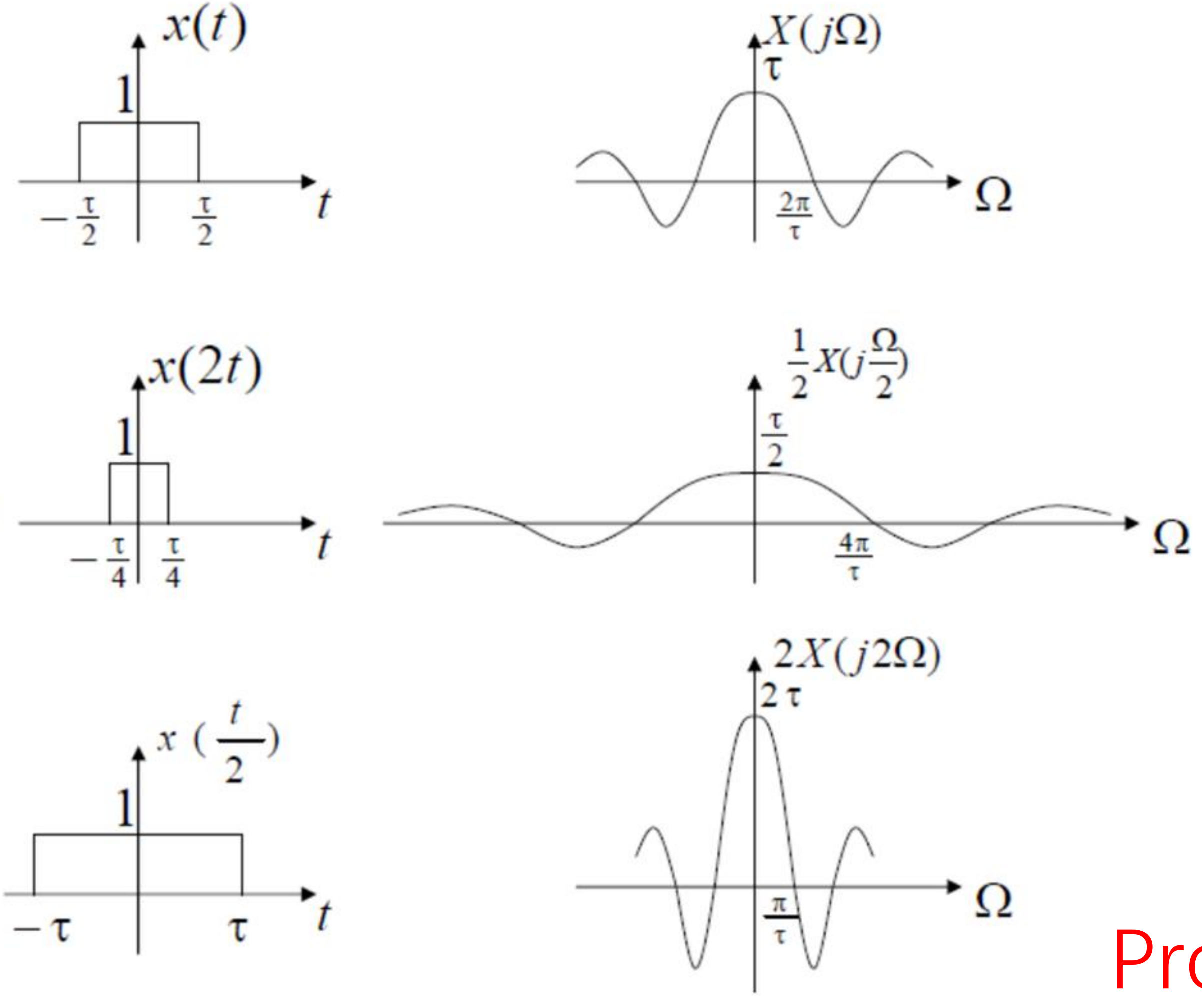
Experimental results

$$x(t) \xleftrightarrow{FT} X(j\Omega)$$

$$X(j\Omega)=\tau Sa(\Omega\frac{\tau}{2})$$

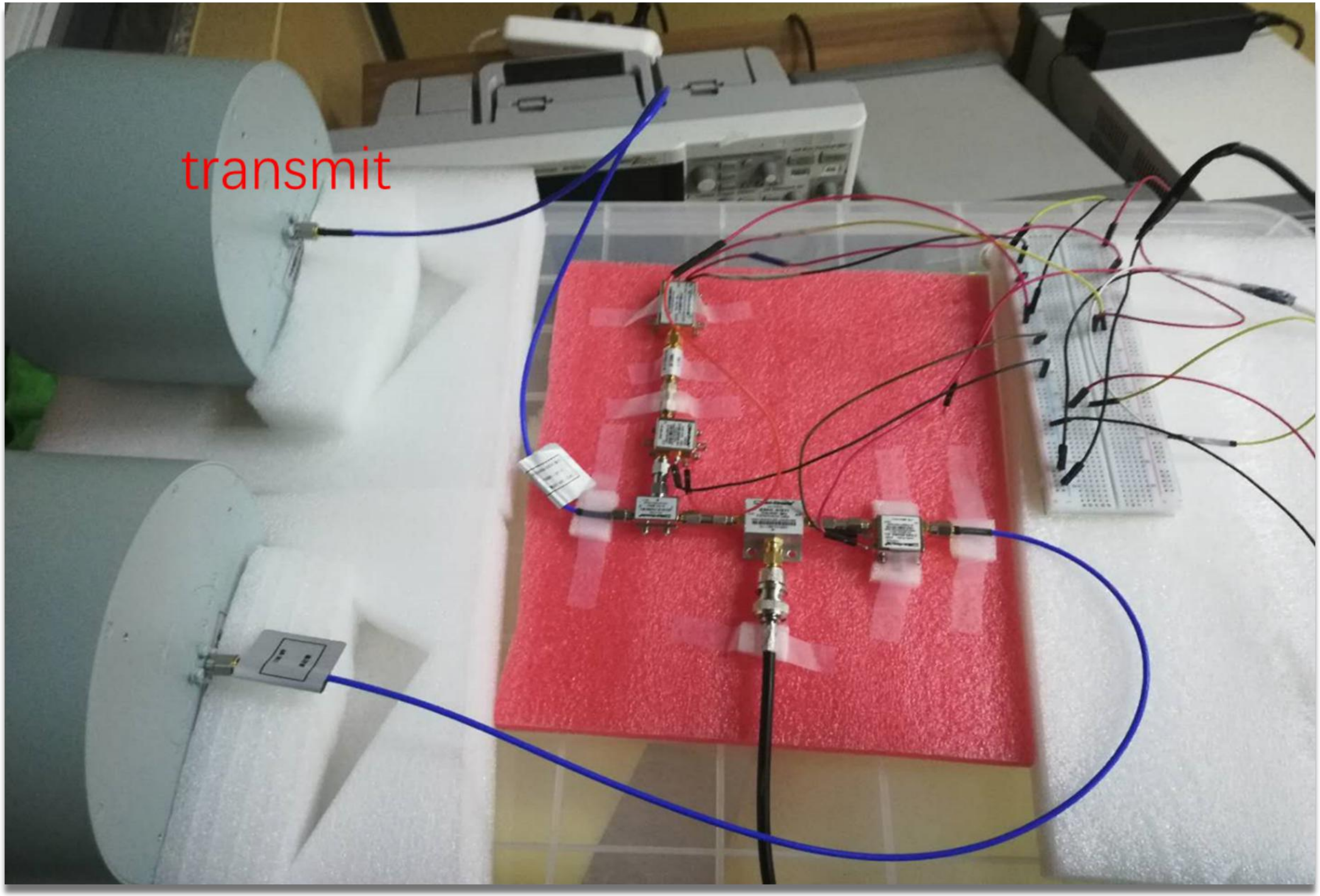
$$x(2t) \xleftrightarrow{FT} \frac{\tau}{2}Sa(\Omega\frac{\tau}{4})$$

$$x(\frac{t}{2}) \xleftrightarrow{FT} 2\tau Sa(\Omega\tau)$$



Professor Ye

Experimental results

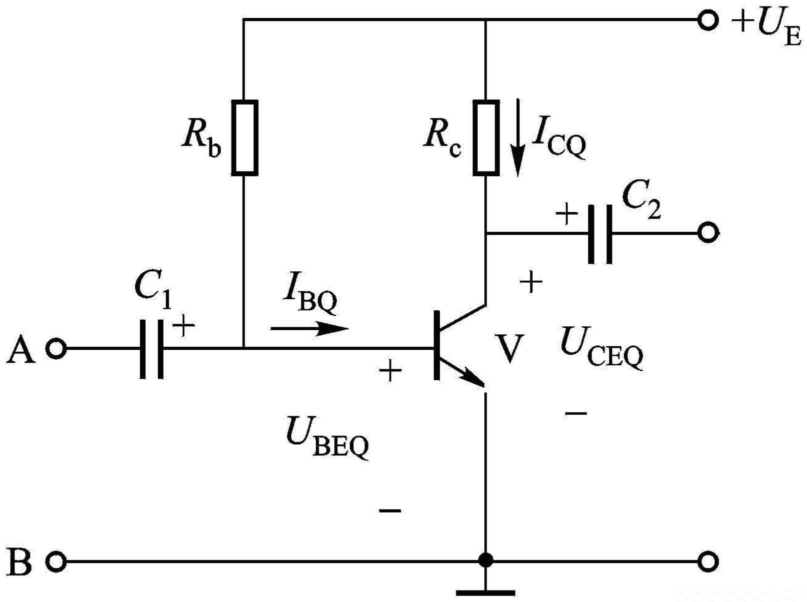


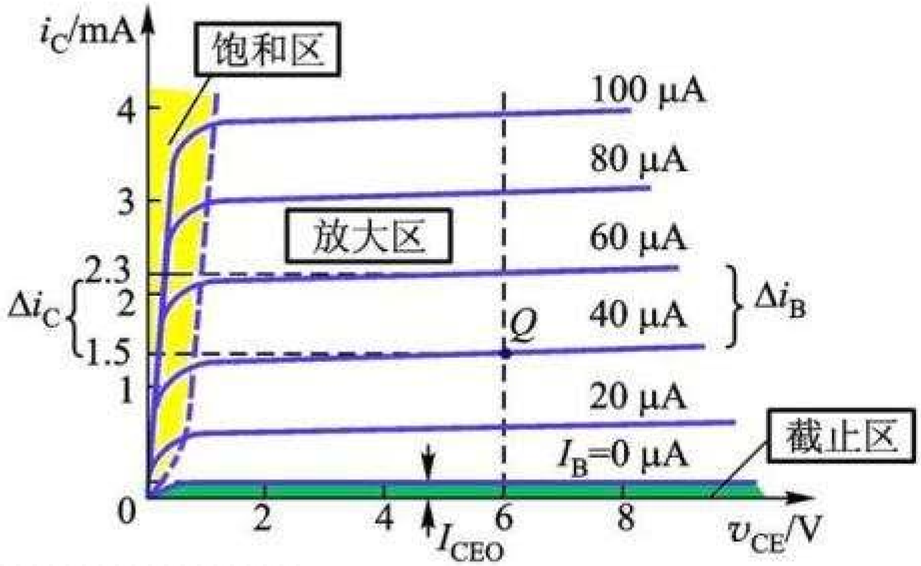
Experimental results

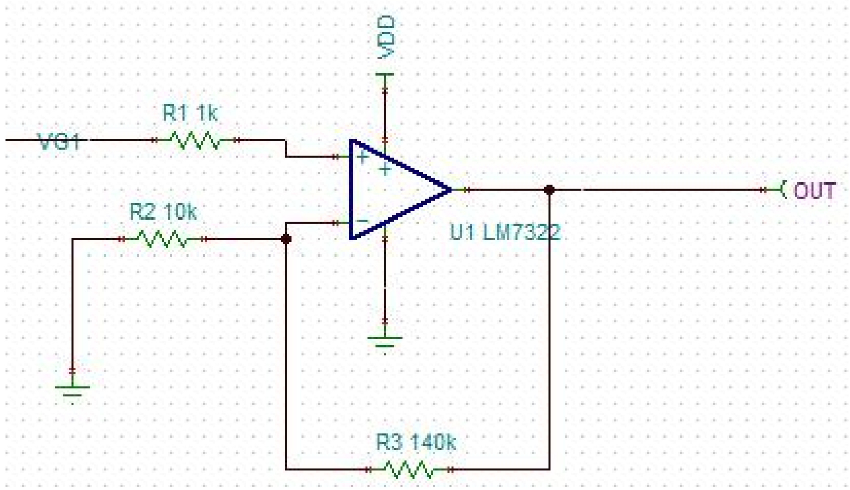
DC-1G

nG~n+G

Experimental results







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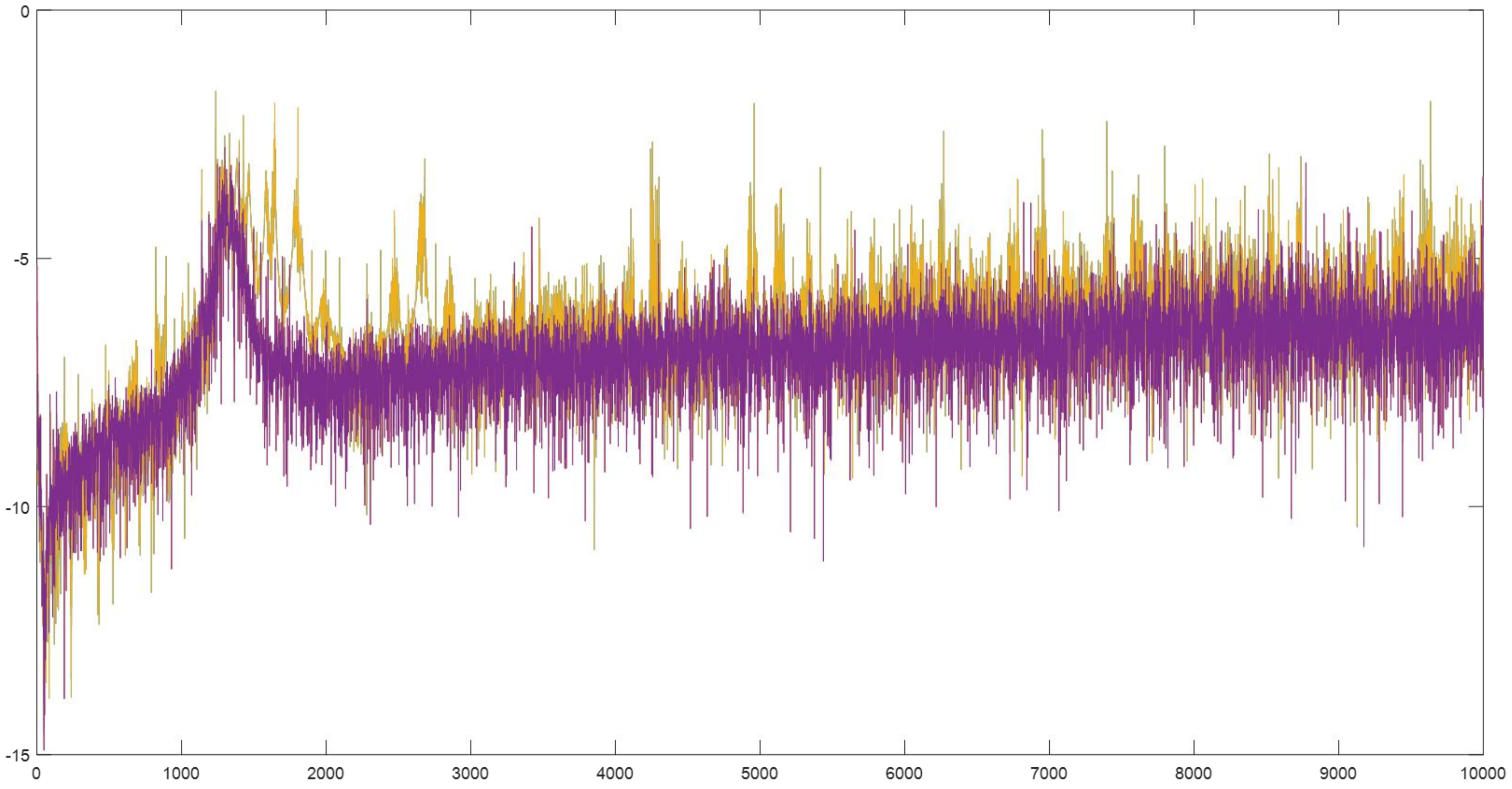

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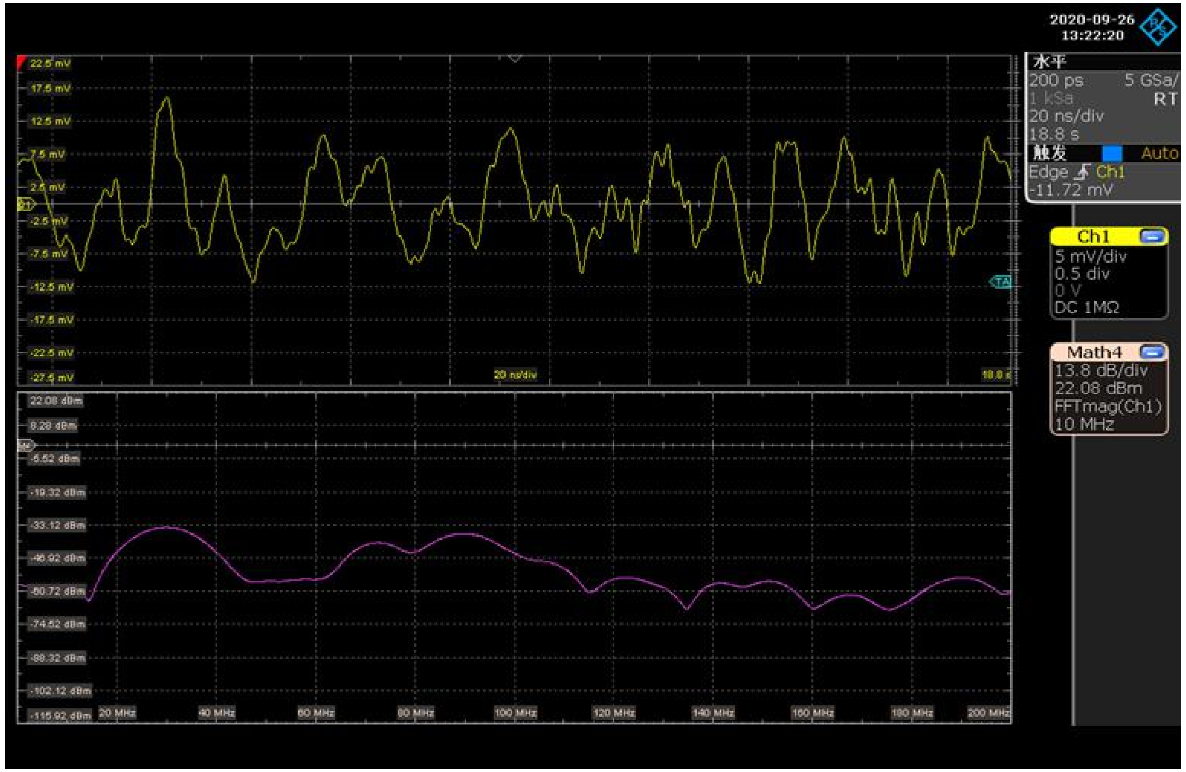

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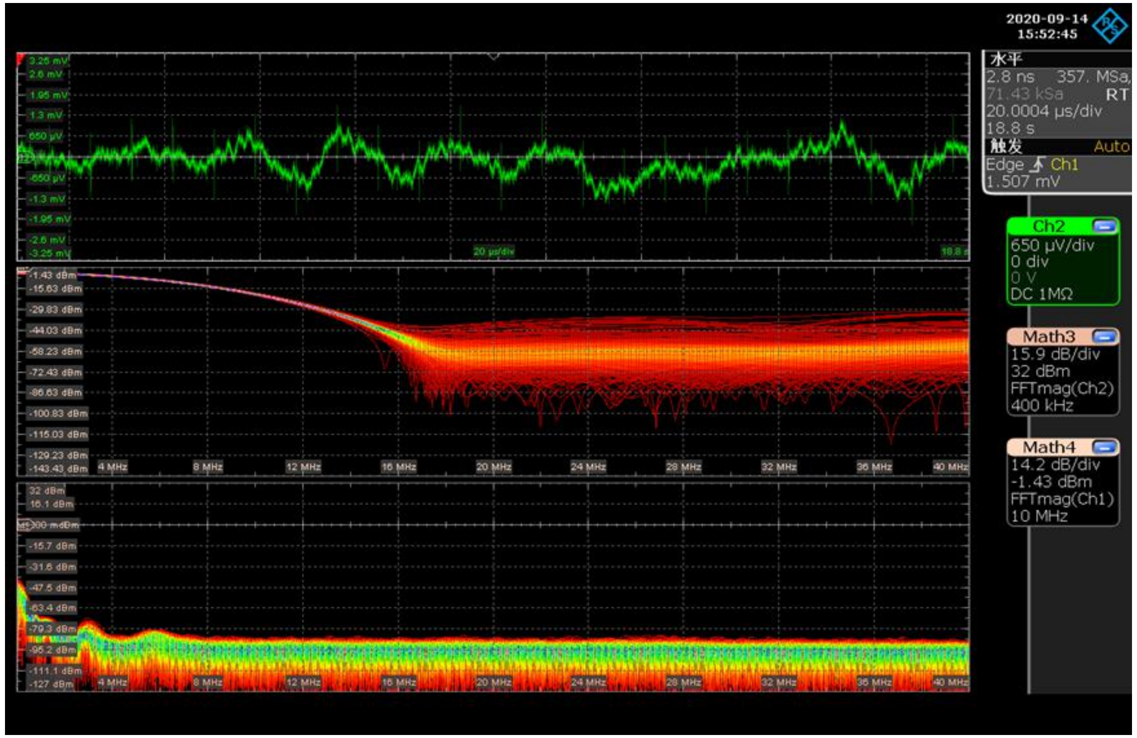

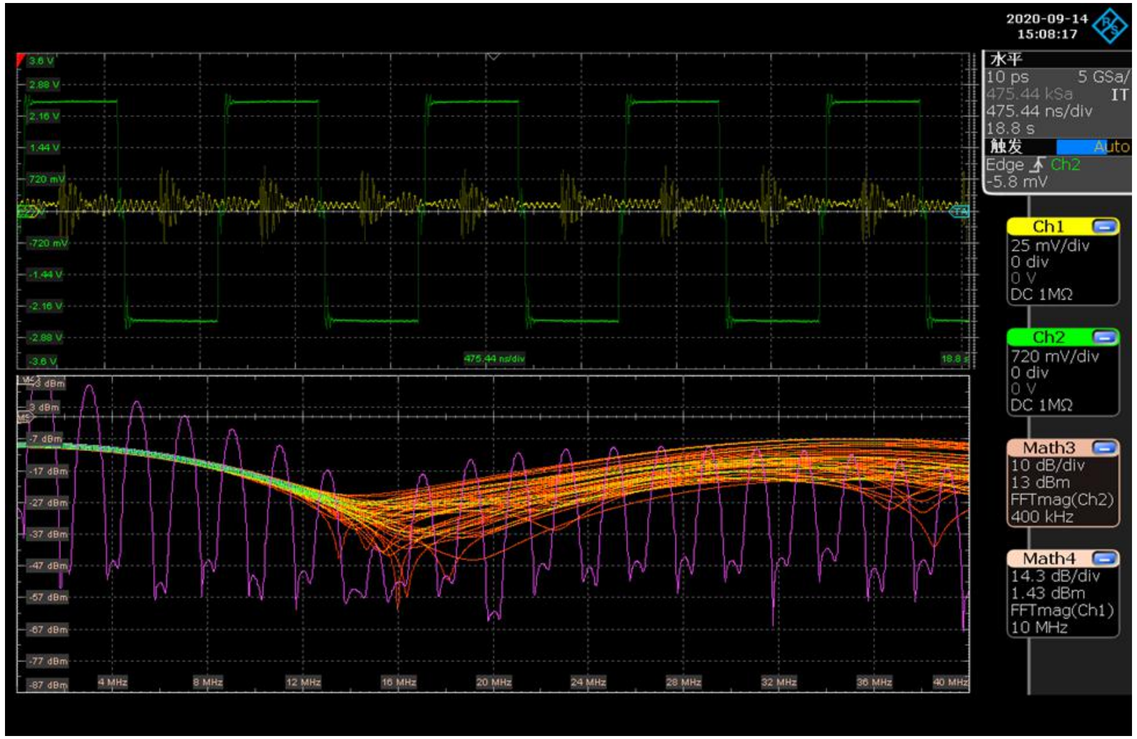

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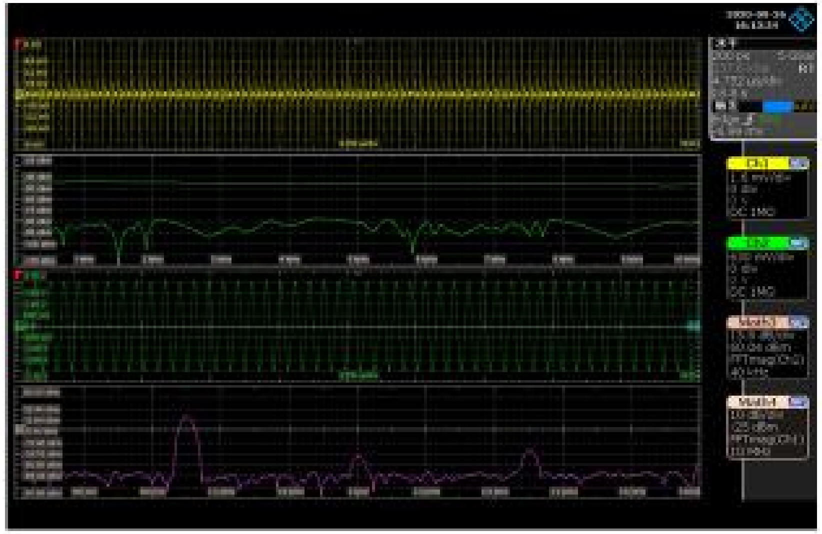

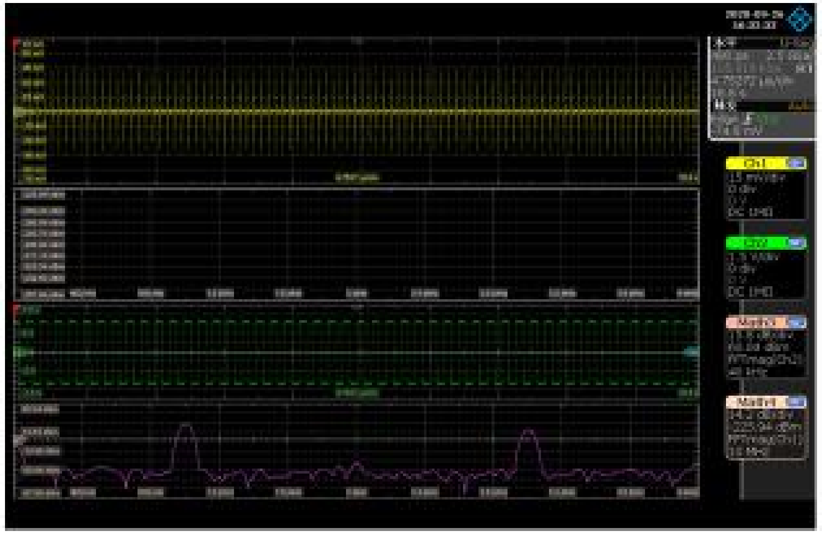

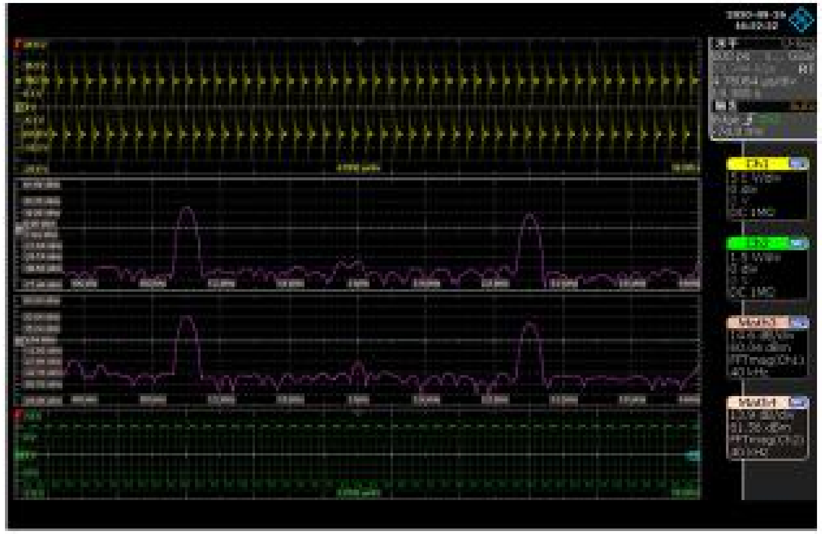

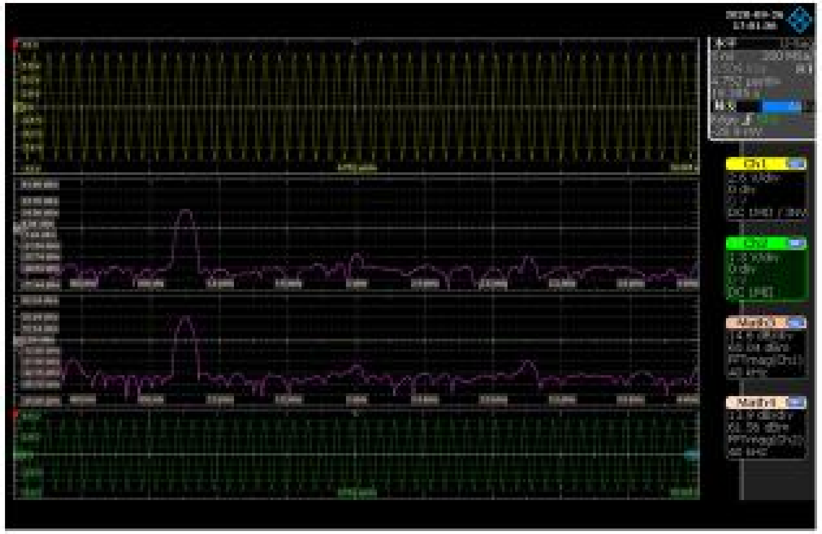

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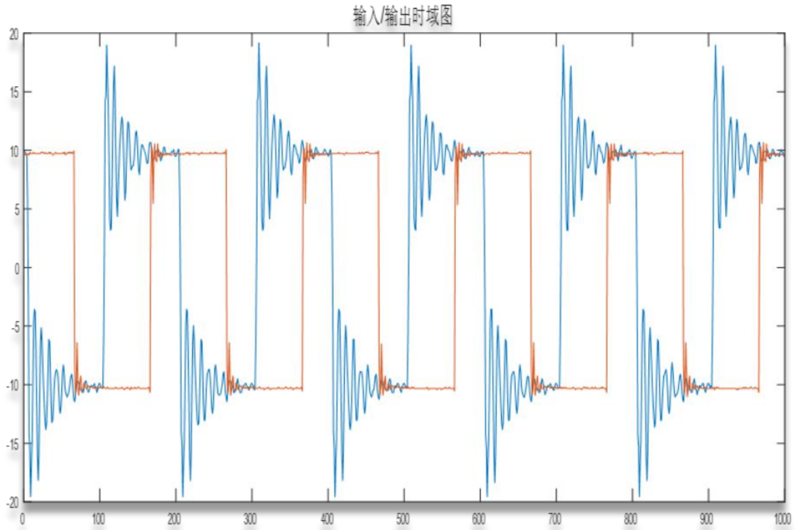

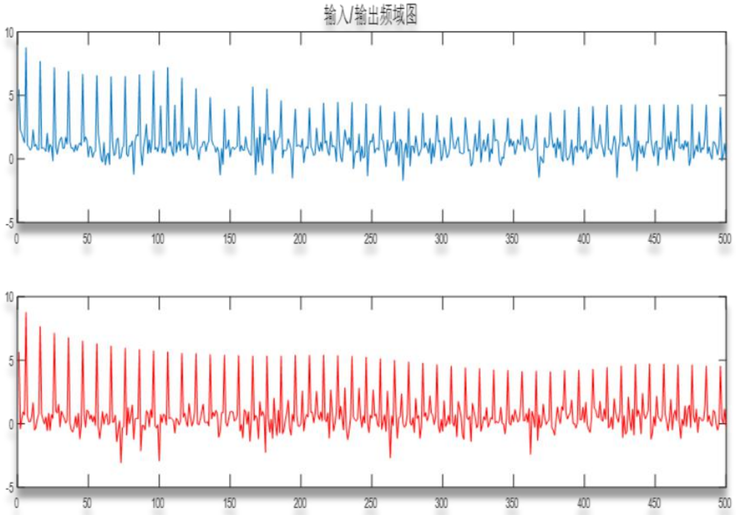

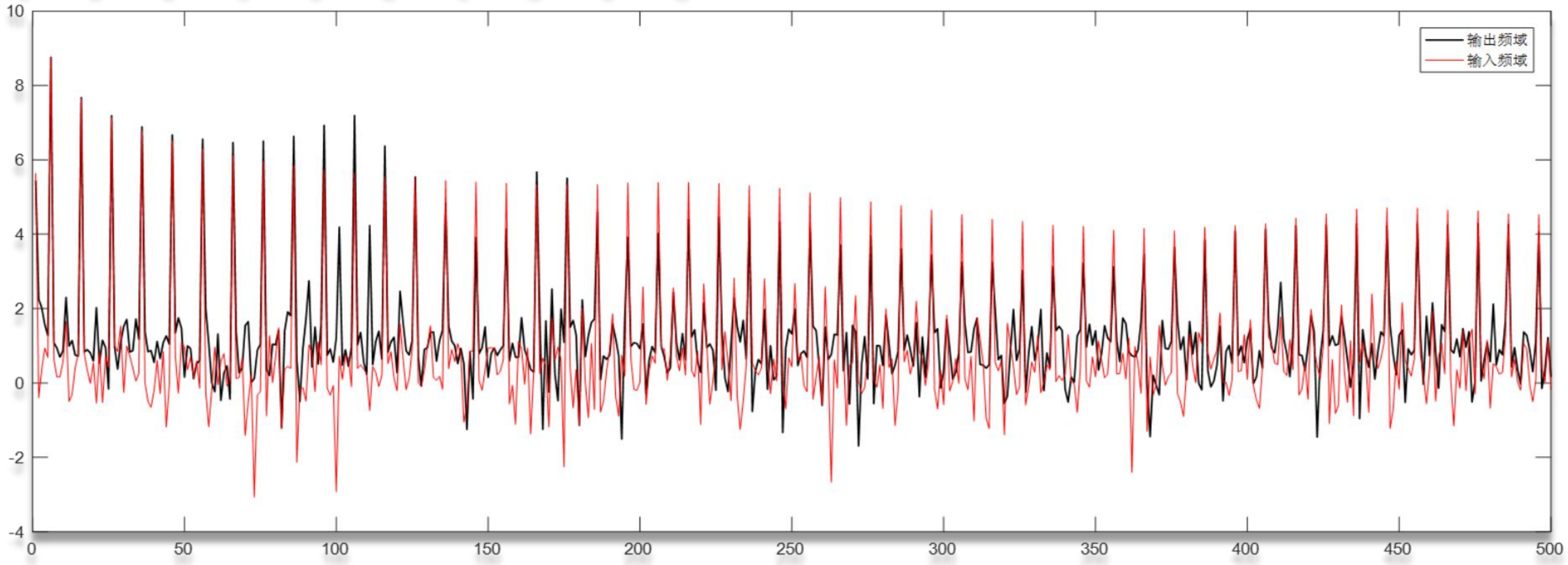

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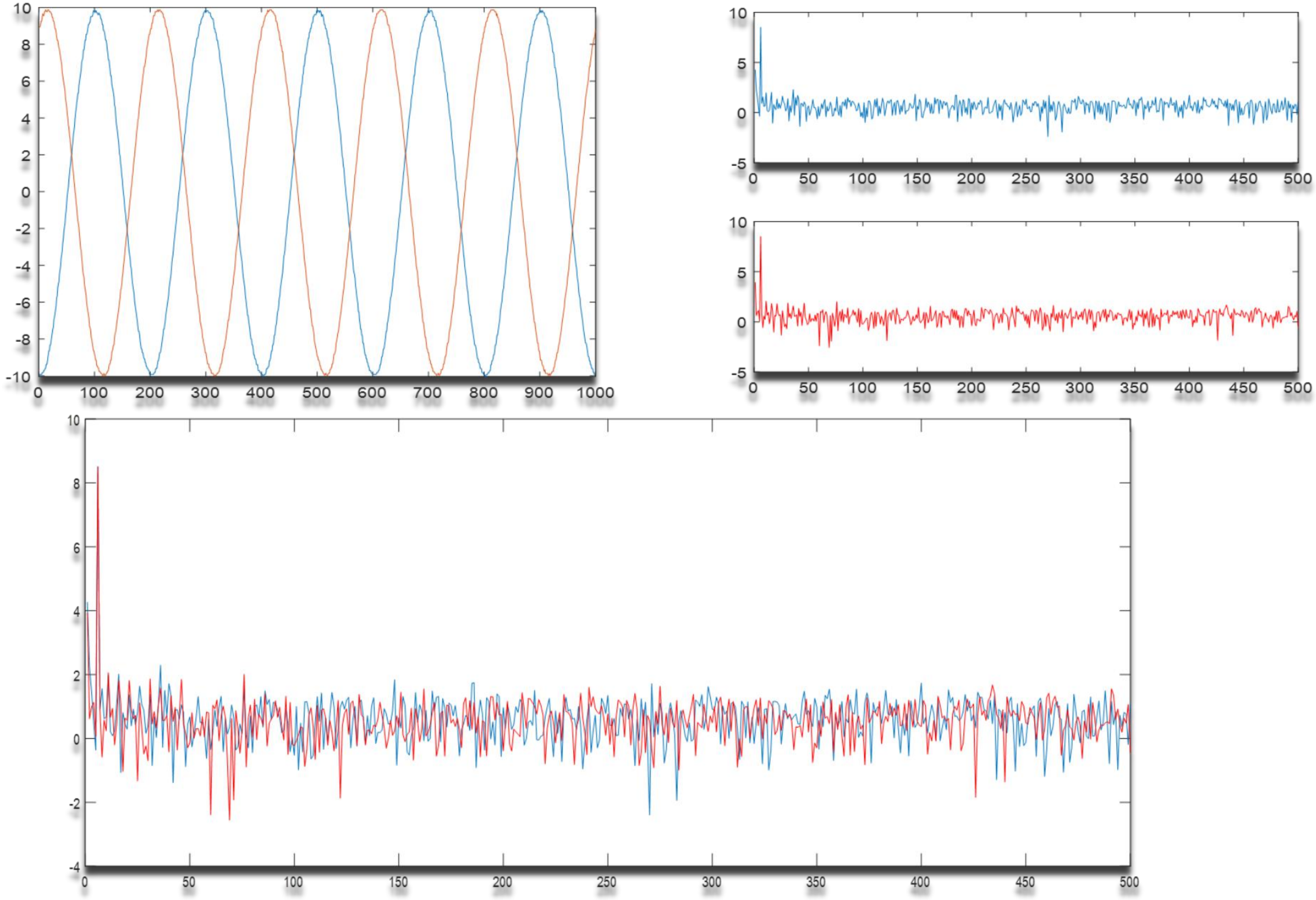

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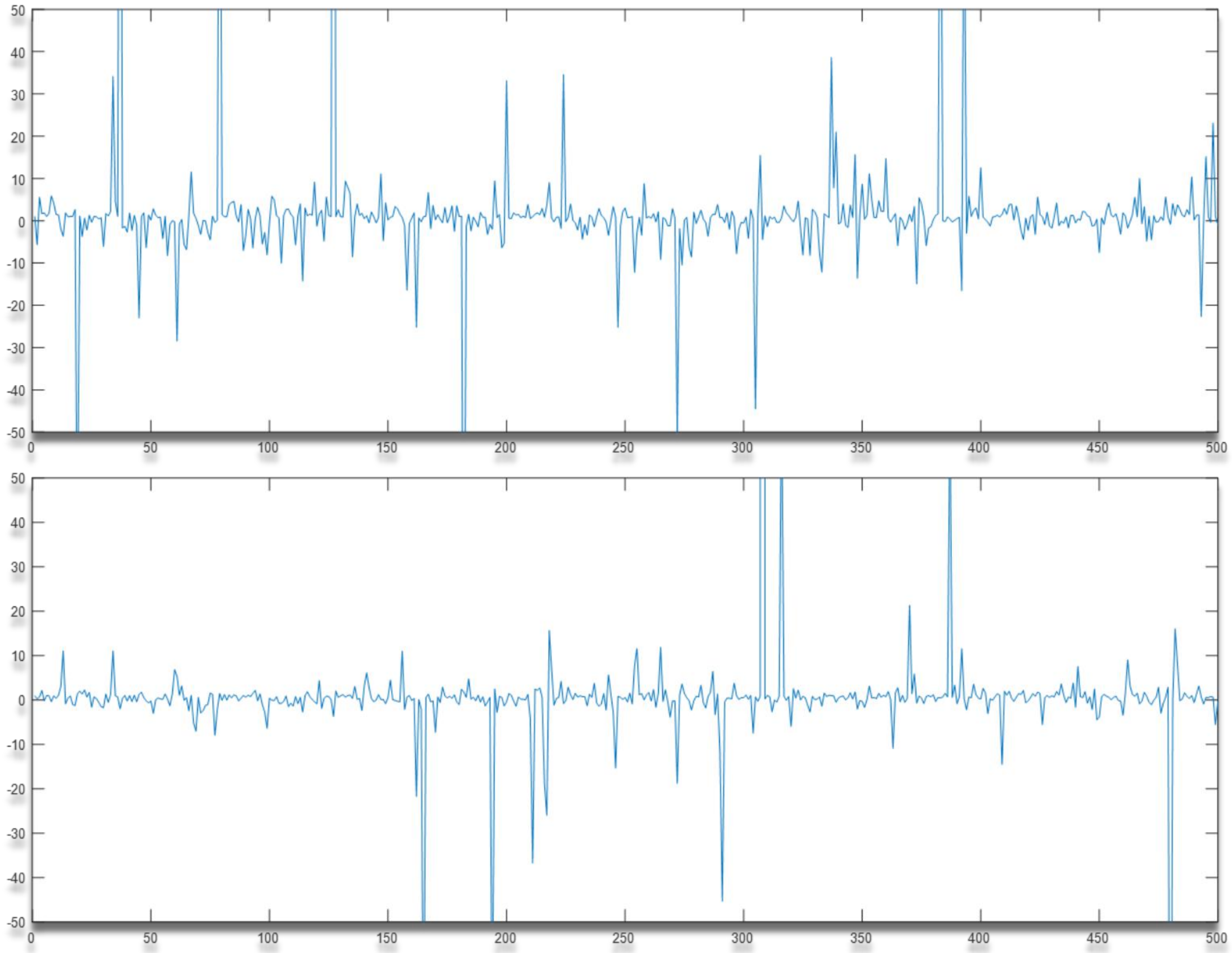

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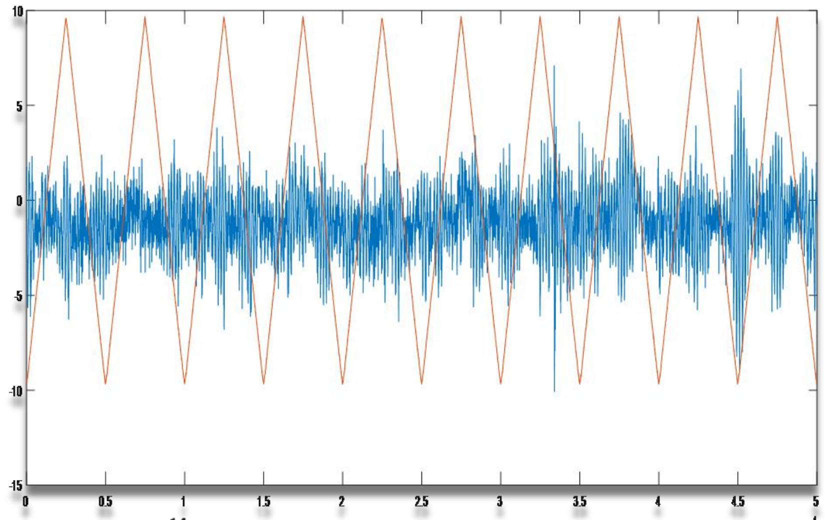

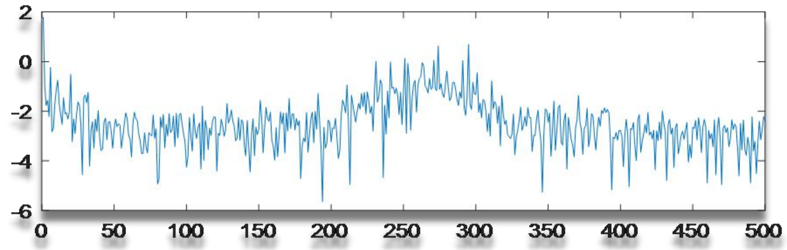

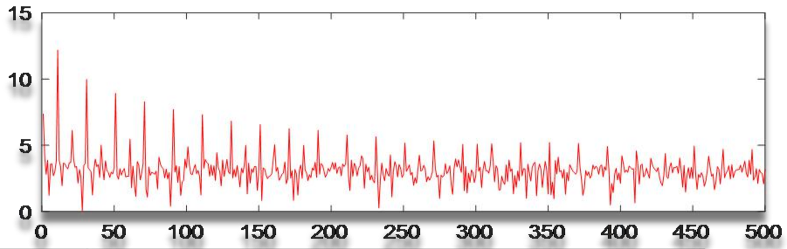

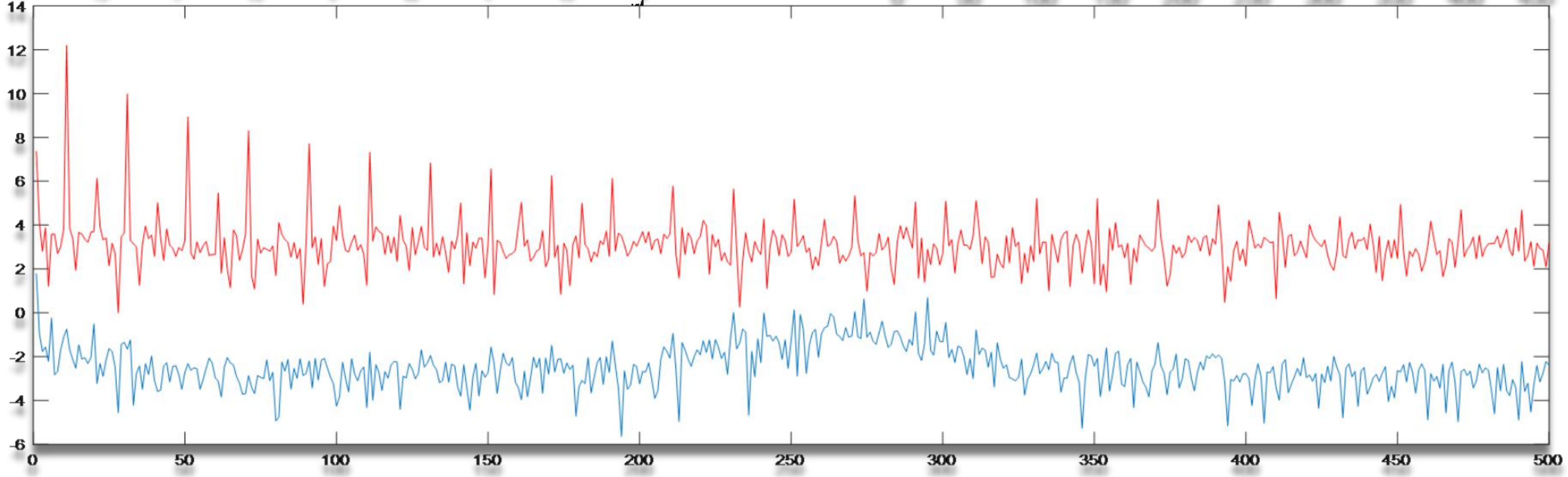

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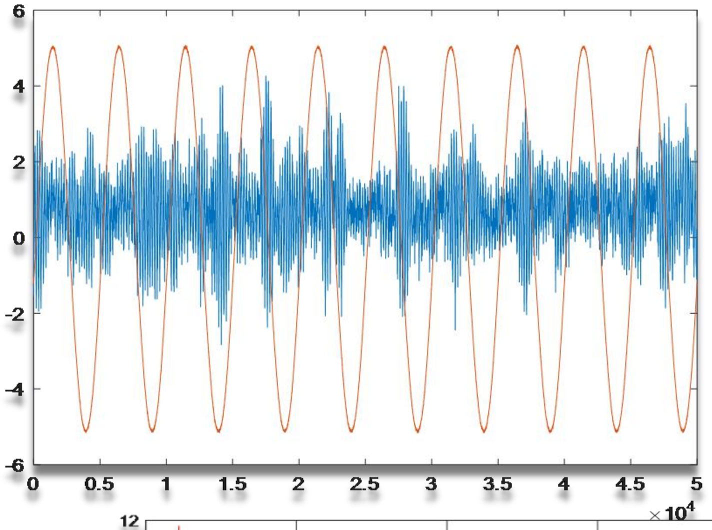

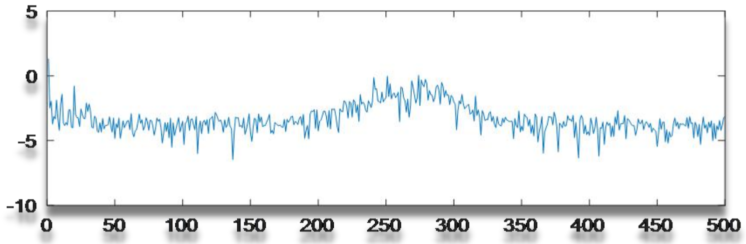

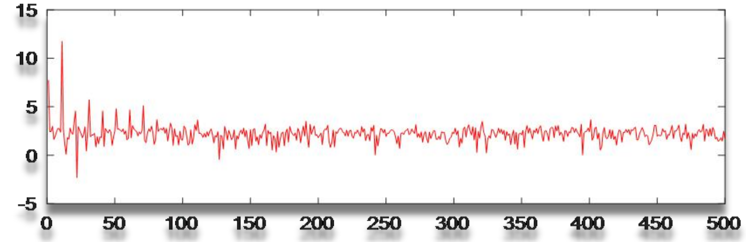

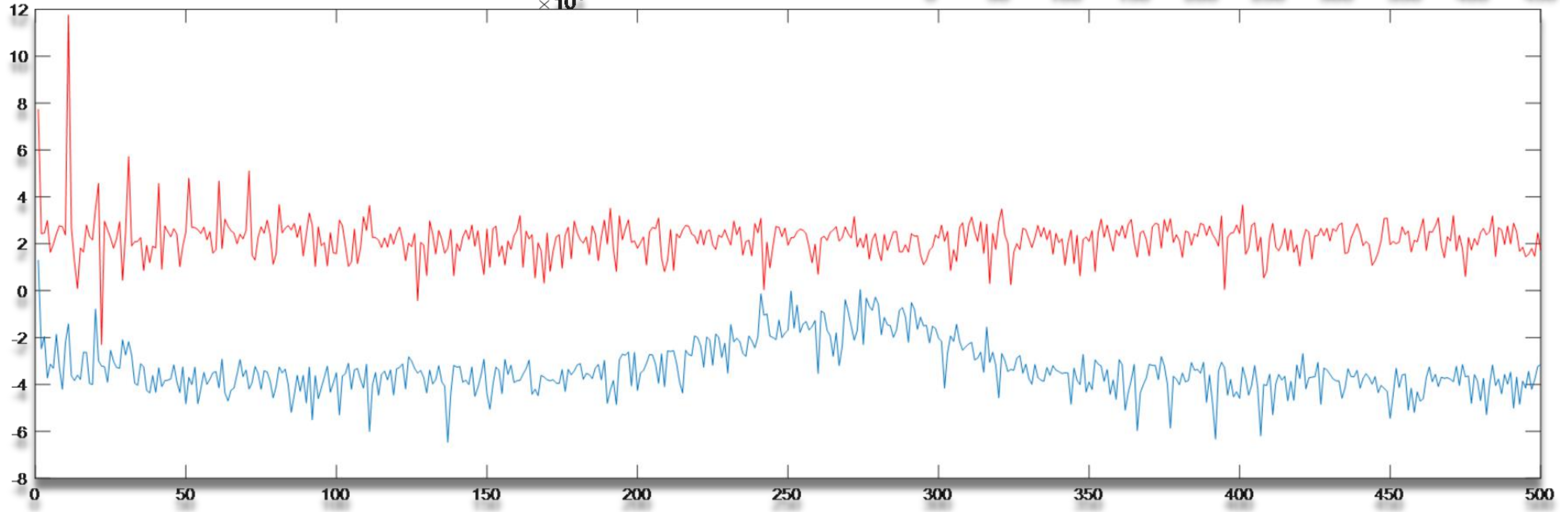

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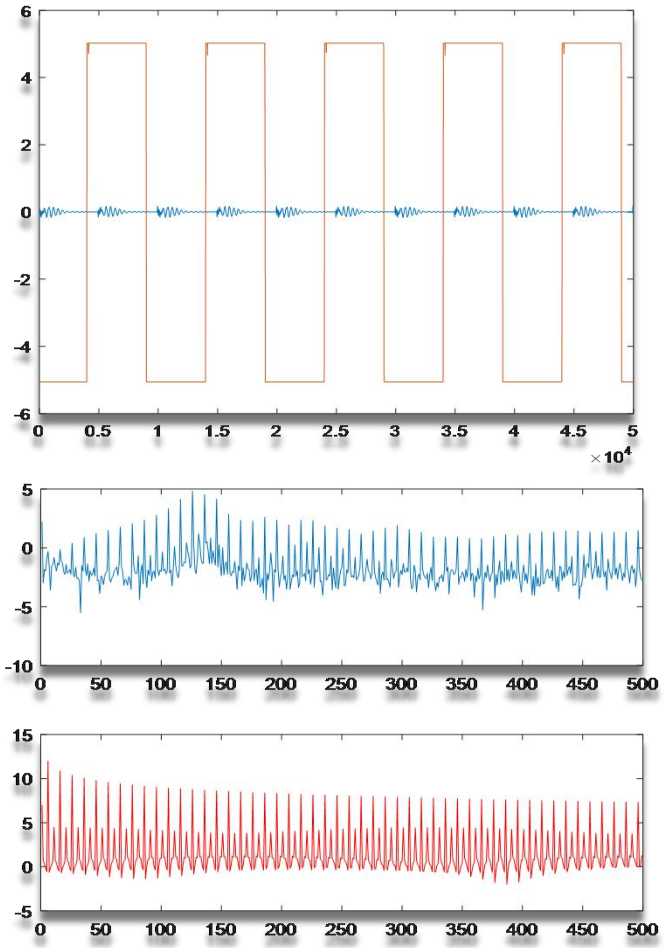

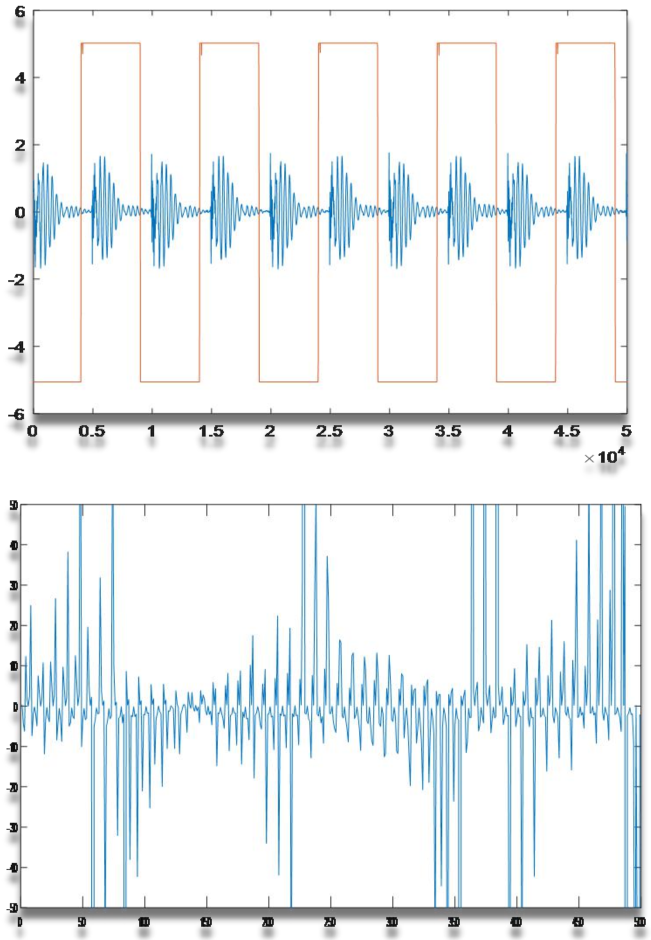

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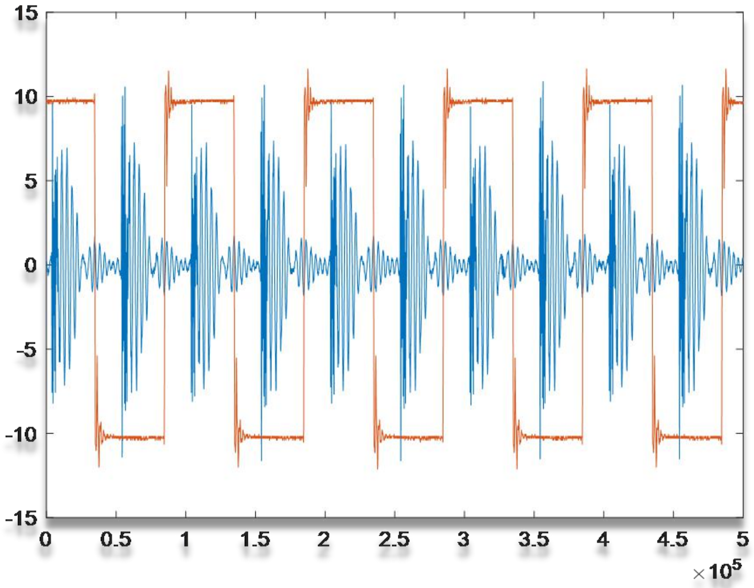
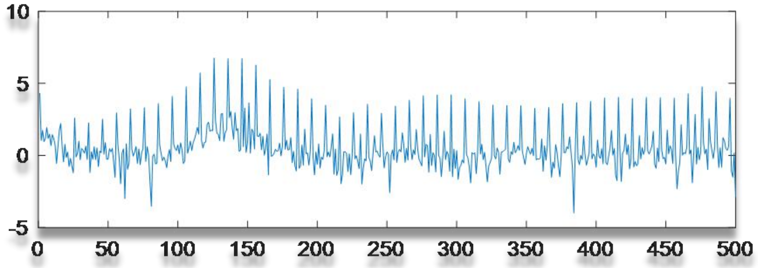
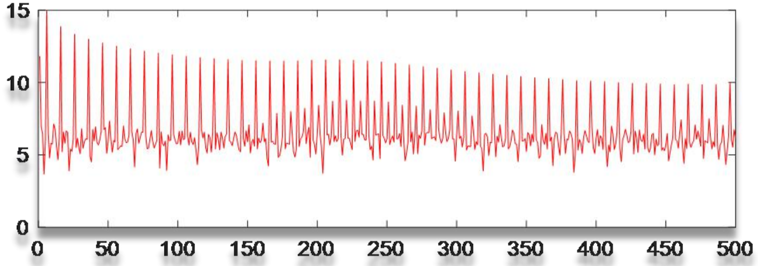
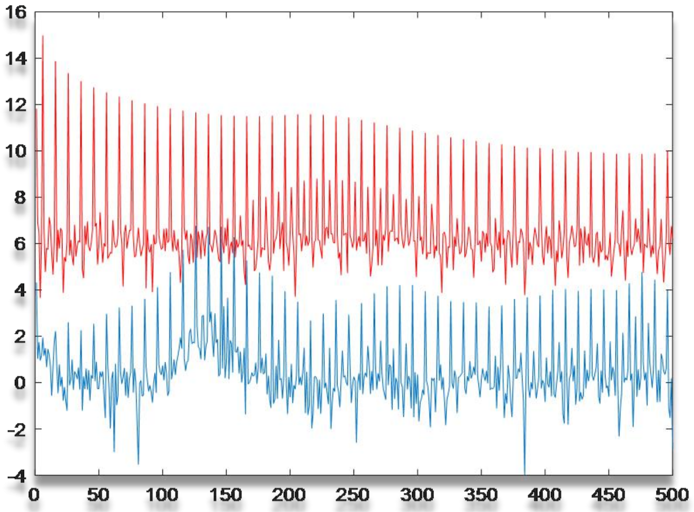
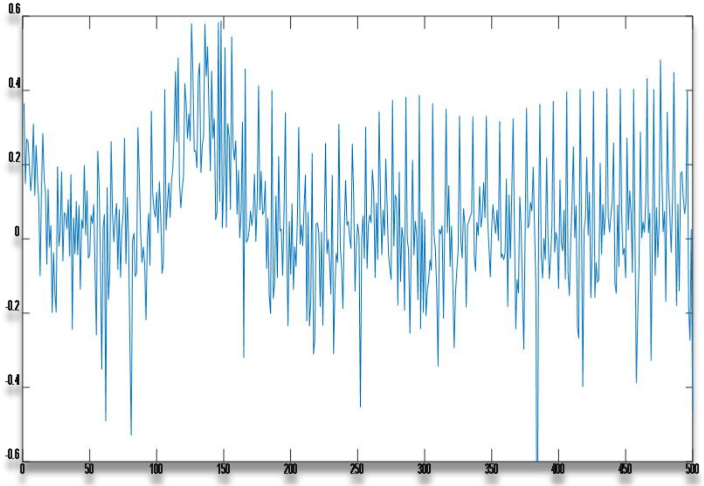
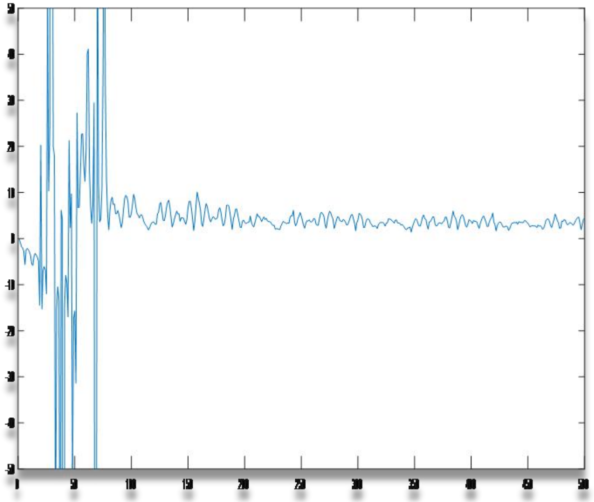








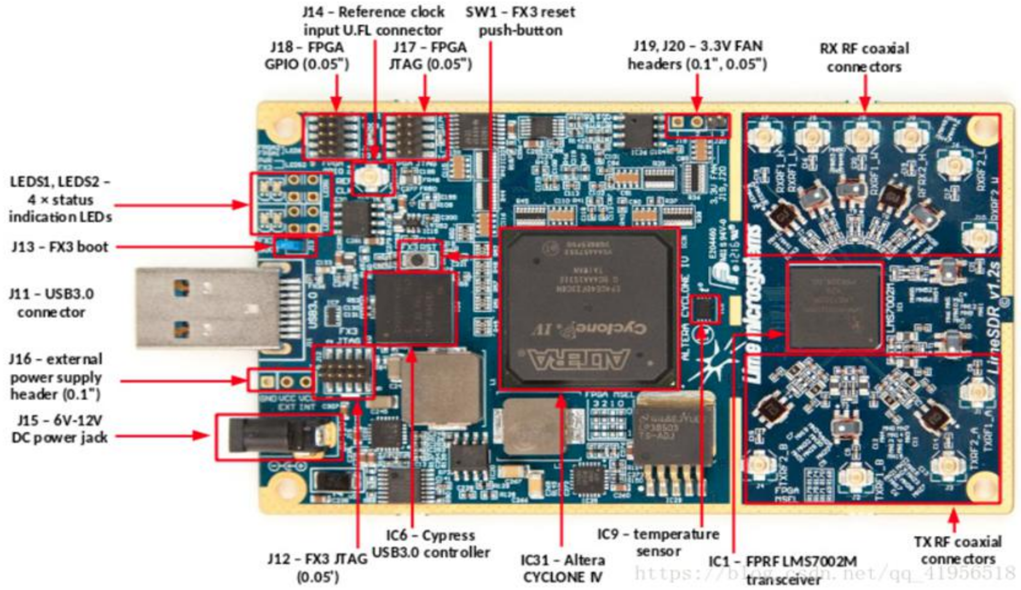




Conclusion/Question

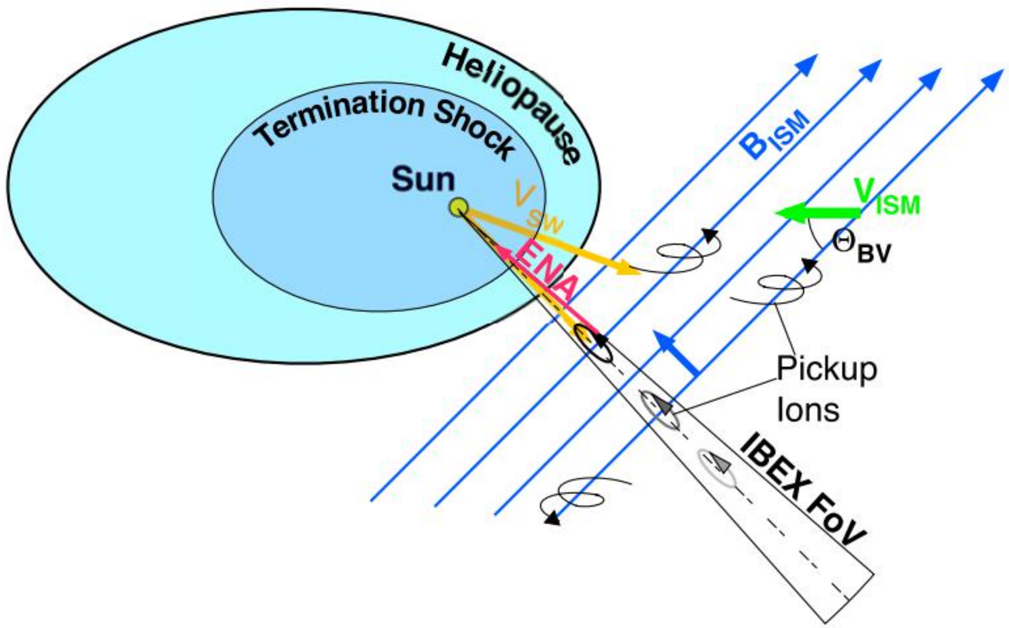
Questions:

- How to determine the fluctuating electric field. (professor Liu)
- How to compute the SDR's response function
- How long is the antenna used.
- What kind of antennas.
- why not the more length of antennas.
- next step using oscilloscope to receive.



USB-VGA-BNC

Conclusion/Question



magnetic field ($\boldsymbol{B}_{\mathrm{ISM}}$), and the Sun. In a first step (described in Section 2.1), neutral solar wind is produced inside the heliosphere through charge exchange between the solar wind and interstellar H atoms. In a second step (discussed in Section 2.2), PUIs are generated from radially expanding neutral solar wind through charge exchange with interstellar H^+ ions. In the plane of Figure 1, PUIs injected exactly perpendicular to $\boldsymbol{B}_{\mathrm{IMF}}$ are convected toward the heliopause at the interstellar flow velocity component perpendicular to $\boldsymbol{B}_{\mathrm{ISM}}$ and accumulated from infinity to the heliopause, as long as there is no pitch angle scattering of these PUIs. The latter provision is an approximation appropriate for a cold PUI velocity ring distribution. In a final step (treated in Section 2.3), these PUIs are converted back to ENAs through another charge exchange with interstellar H atoms. Because PUI

Conclusion/Question

Professor Liu   it is that not transmit all signal component

放大前后的信号对比